CNN-Based Early Detection of Acute Ischemic Lesion

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CNN-based methods on CT's are introduced in this paper. Medical imaging systems produce volume images featured by characteristics of diagnostical significances which can hardly be appreciated by human vision. Telemedicine is a hot topic of information processing. A decision support means for the early detection of acute ischemic stroke as a part of a telemedical consulting system is outlined in this paper. CNNUM stands for real-time image processing support for a medical expert by the detection of image features which can be misrecognized by a human. Segmentation of CT images is particularly dedicated to a multilayer CNN which provides a huge computing power on 2.5 -D volumes.

Detection of neuroradiological significances primarily based on a grey scale. Mapping pathological syndroms unambiguosly to image features is crucial. Substitution of accumulated medical knowledge by definite formulas is extraordinary relevant. Appearance sort of symptoms strongly depends on age, sex, risk factors, on blood pressure, conditions of main organs, and also on epidemiological antecendents. Building some anatomical knowledge can hardly be avoided. Searching is done by both shape and shade of gray in noisy medium. Falx cerebri, optionally the Putamen, Caudate nucleus, Thalamus, Internal and External capsules, the Insula, Hemispheres, Sulcuses, hyperdensity and homogenity are examined by original parallel local methods implemented by analogic CNN algorithms. Entire grey scale covers hardly a small range of the scale of CT numbers which correspond to the attenuation of different type of tissues. Depending on the tissue of interest a neuroradiologist scales the gray scale window.

Both artifacts and malpractice can be corrected by simple preprocessing techniques. A set of simple template operations may help getting a flawless input image. These adaptive rescaling techniques are shown as prefiltering, a combination of eliminating the irrelevant structures by band-pass filtering and a contrast enhancement.

MRF Image Segmentation is presented demanding a tremendous amount of computing power which can usually be implemented on parallel computing structures, however. Optimal image labeling is performed by minimizing an energy function

$$E(\omega_s, f_s) = \sum_{s \in S} \left(\ln\left(\sqrt{2\pi\sigma_s}\right) + \frac{(f_s - \mu_s)^2}{2\sigma_s^2} \right) + \sum_{C \in \mathbf{C}} \beta_C,$$

where s stands for a site, ω_s is a configuration, f_s is the observed grey level image data, μ and σ stand for mean value and standard deviation, respectively. C is a clique and β_C stands for a parameter that depends on the neighbourhood. One possible way for optimization is a derivation of a PDE that is implemented by the CNN. In the proposed model an anisotropic diffusion model is used

$$F(E(\omega_s, f_s)) = \int_S \left[\Psi(E) + \Phi\left(\|\nabla E\|\right) \right] d\omega_s df_s.$$

Acknowledgements: This research has been supported by National Research and Development Funds of Széchenyi Plan under consortium NKFP OM-2/052/2001 and OTKA #029609. Discussions are kindly acknowledged to Prof. P. Szolgay, P. Barsi, L. Czúni.

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